Extending food Shelf Life – Alternatives technologies proposed by Cirad

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UMR 95 QUALISUD
Integrated actions to obtain high quality food

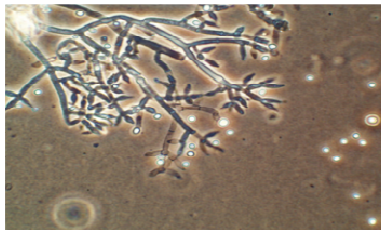




UMR QualiSud

cirad | Montpellier SupAgro Institut des Régions Chaudes | UM1 Université Montpellier 1 | um2 Université Montpellier 2 Sciences et Techniques






Scientific structure of UMR in 2011

Axe 1
Caracterization and understanding of fresh and processed foodstuffs

Axe 2
Process mastering for a better safety and nutritional qualities

Team 1

1-Study of metabolites of interest, nutritional and biological and ogranoleptic

2- Physiological mecanisms and elaboration of quality

Team 2

3-Mastering micropolluants (r[illegible]dues, toxins)

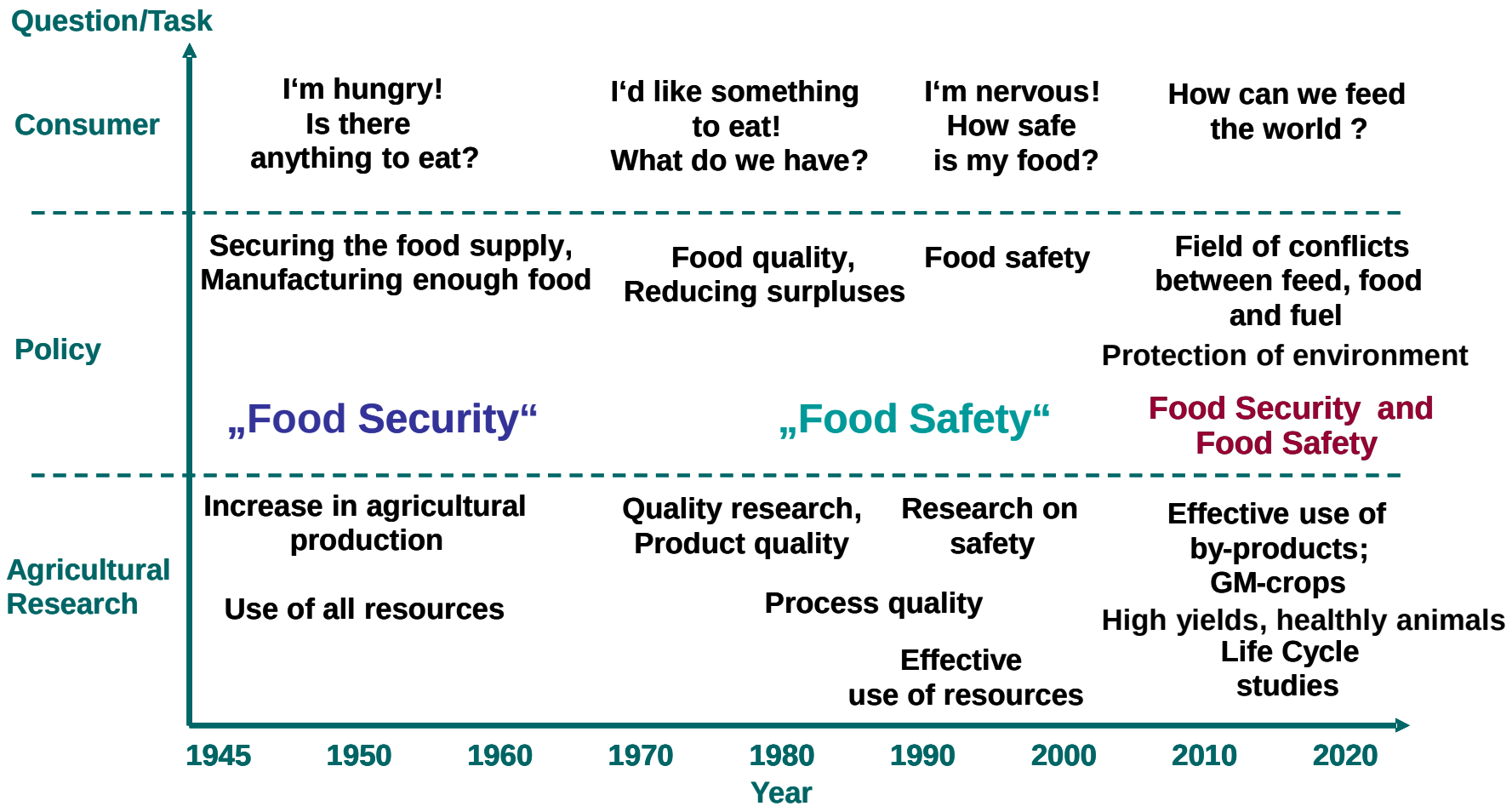
4-Post récolte Traitements & [illegible]anitary quality of fresh products

5-Study couplage of transfert & reaction phenomenoms

6-Ingenierie of complexe food systems

Team 3

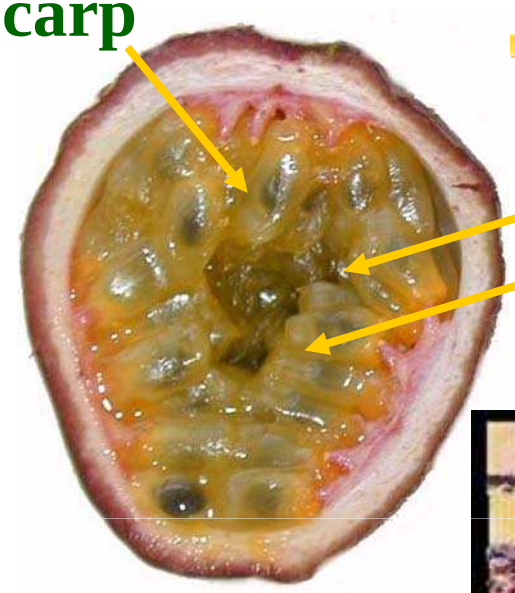
Dominating questions of society after the 2nd World War in Europe, presently and in future



Flachowsky, FLI, Germany, 2008

Flash explosion process

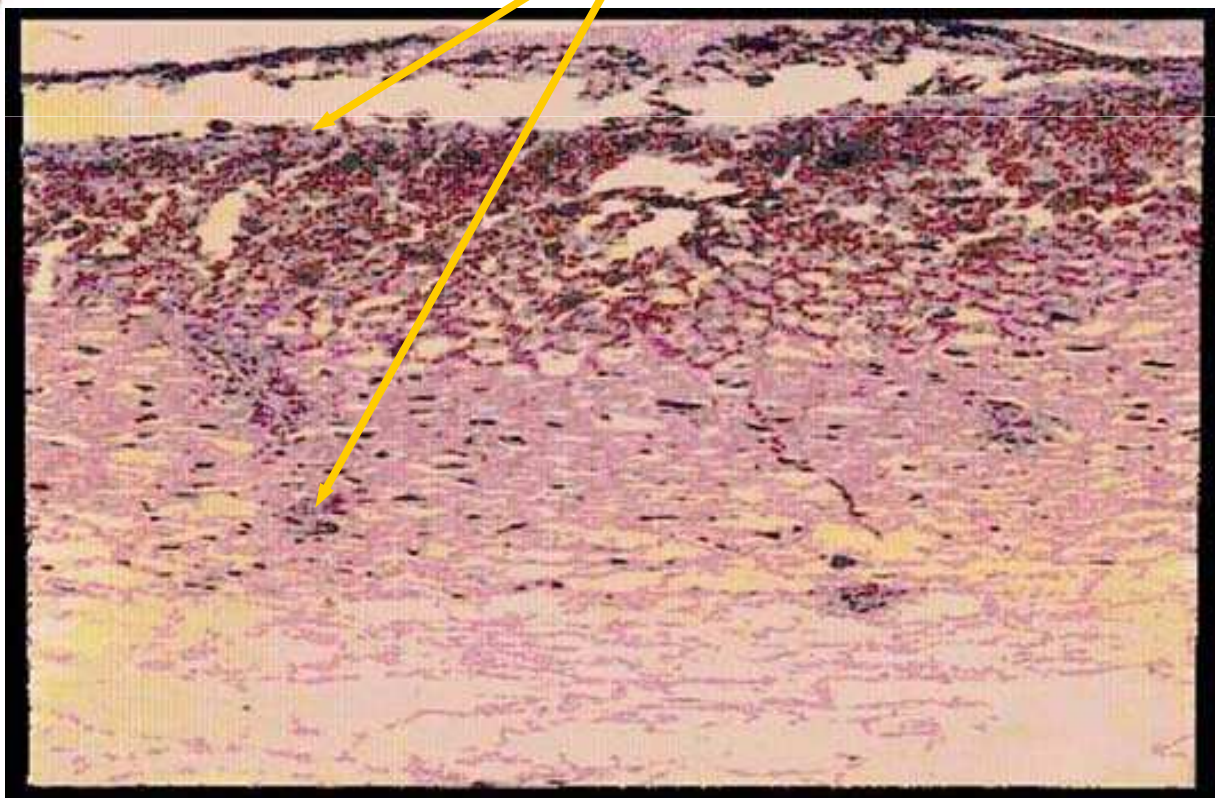
Mesocarp



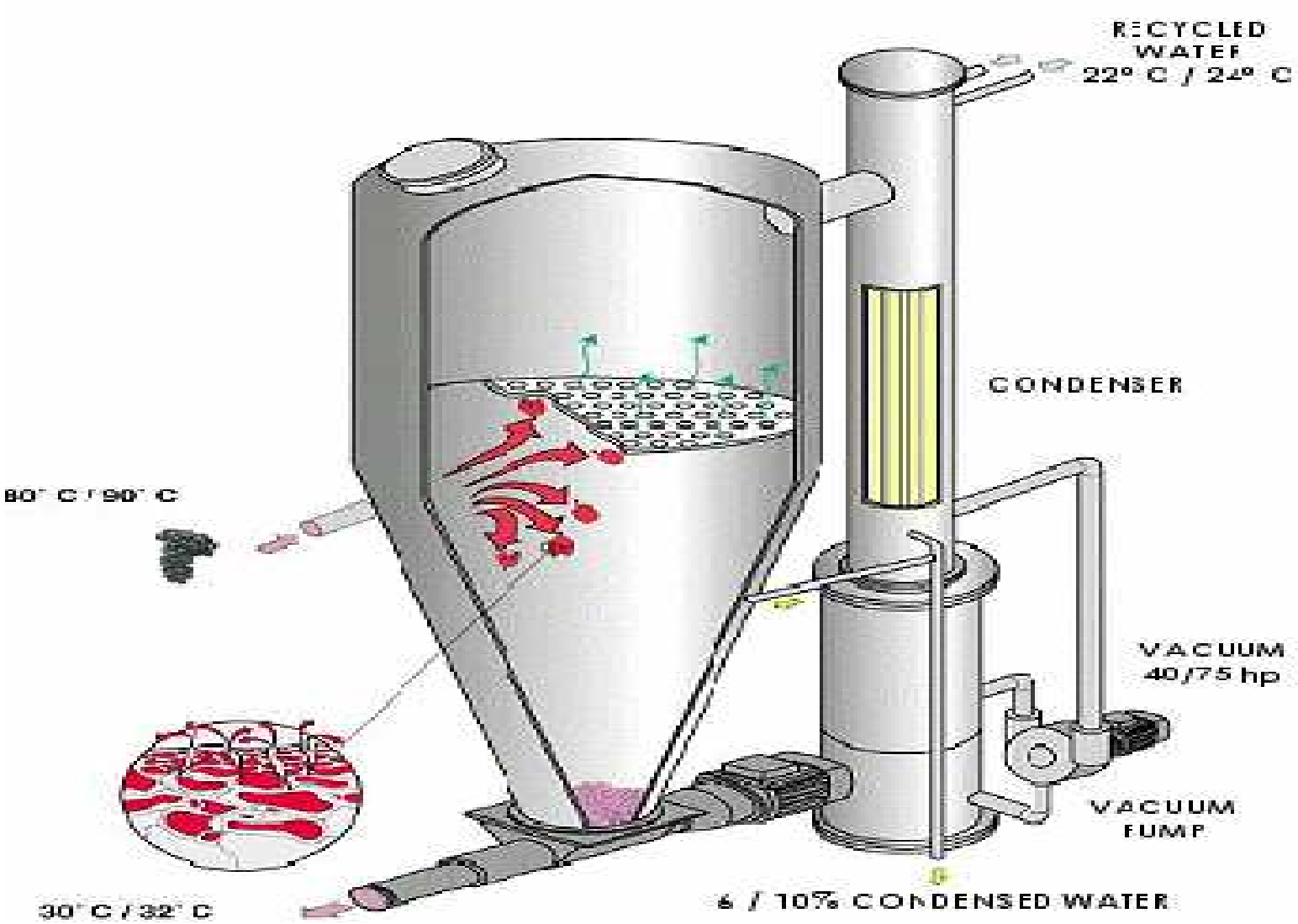
Aril

Épicarp

Steam injection



Equipement of flash explosion



Flash explosion: general view of pilot

Fruits conveyors

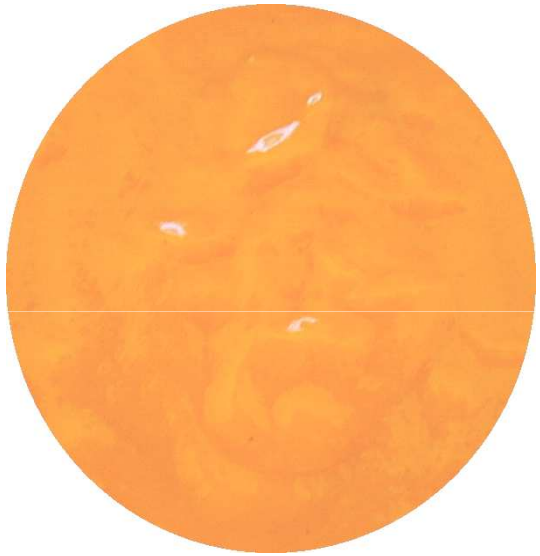
Steam area

Main characteristic of flashed passion juice

	Standard juice	Flashed purea
pH	3,2	3,8
Titrable acidity	44,3	31,5
O_2 Content	100	20
Passion fruit juice extraction	26	49
Anthyocians content (mg/l)	3.9	45.7

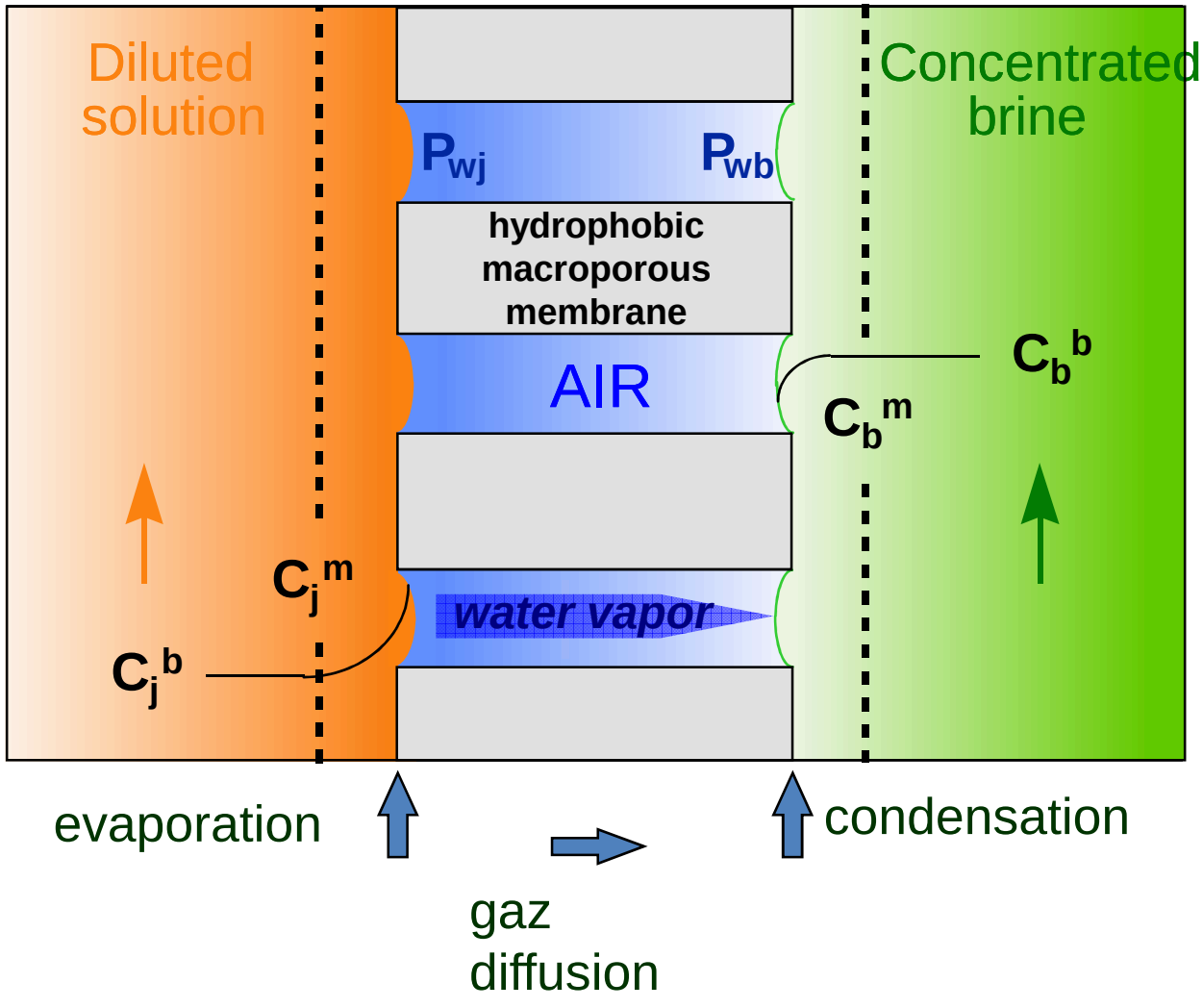
Comparative of mangoes juices

Standard



Flash-detent product

Principle of osmotic evaporation



Membrane technology: Cold concentration by osmotic evaporation

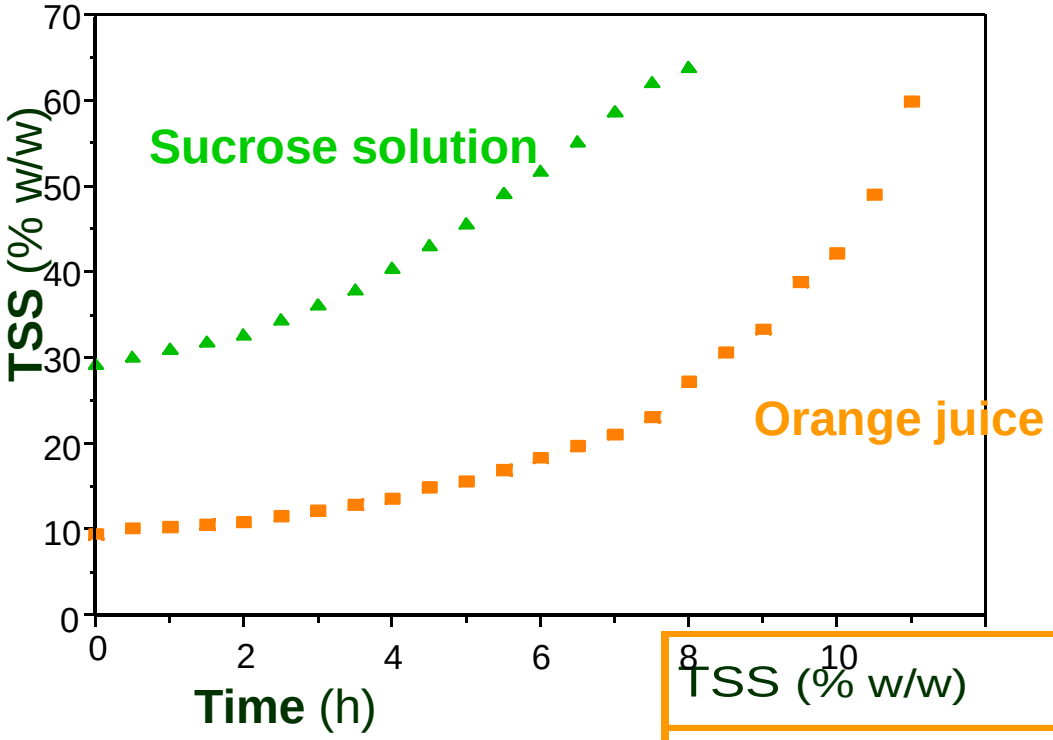
Interests of the process

- No difficulty to reach high TSS ⇒ **high concentration level**
- Ambient temperature: no thermal degradations
- Total retention of non-volatile solutes
- Losses of volatiles limited ⇒ **high quality concentrates**
- Atmospheric pressure / easy to drive ⇒ **moderated cost**

- **The concentrated brine**
- Low water activity ($a_w < 0.8$)
  - high soluble salt, multivalent salt
- No toxicity
- Moderate cost

⇒ **$CaCl_2$ 5.5 $mol.l^{-1}$ (45.5% w/w)**

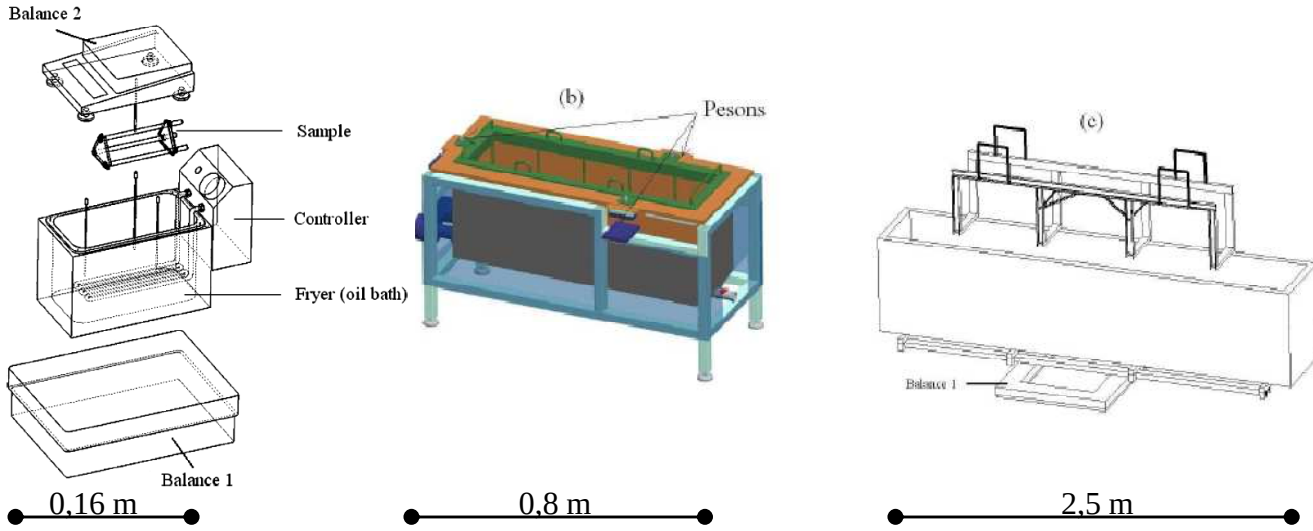
Quality of concentrates: orange juice



100 L of juice on plate and frame
PVDF membrane at 28°C

	Fresh juice	Osmotic evaporation Concentrate
TSS (% w/w)	13.5	60.0
Acidity (g/TSSkg)	0.89	0.89
Sucrose (g/TSSkg)	3.3	3.3
Glu+Fru (g/TSSkg)	3.3	3.4
Vit. C (mg/TSSkg)	**24**	**22**

Chips with low fat contents produced by frying technology

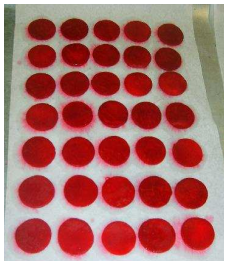


Frying machine with automatic weighting balance

Production of green papaya chips formulated with Blackberry Juice

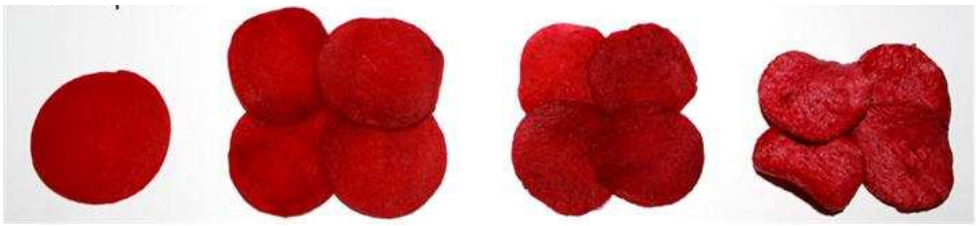
Osmotic dehydration

Blackberry Juice



Frying

chips



Combination of osmotic dehydration and frying

Pineapple

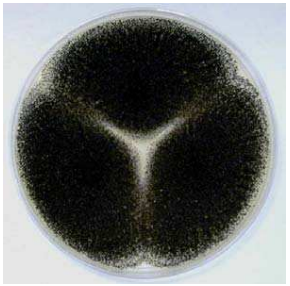
Papaya

Cashew

Banana

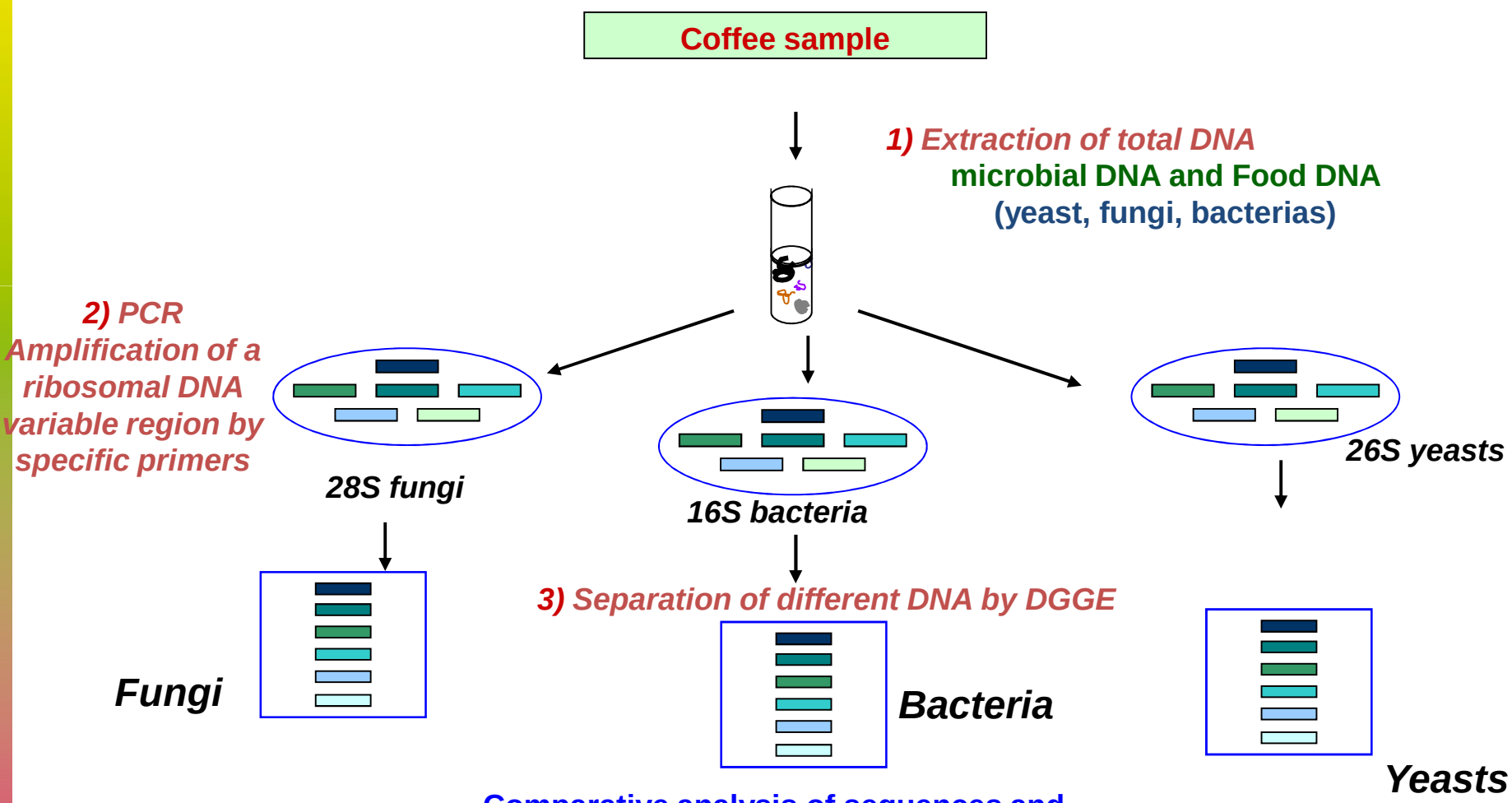
New analytical technique to follow the dynamics of microbial population:

DNA fingerprinting by PCR-DGGE applied to toxinogenic fungi

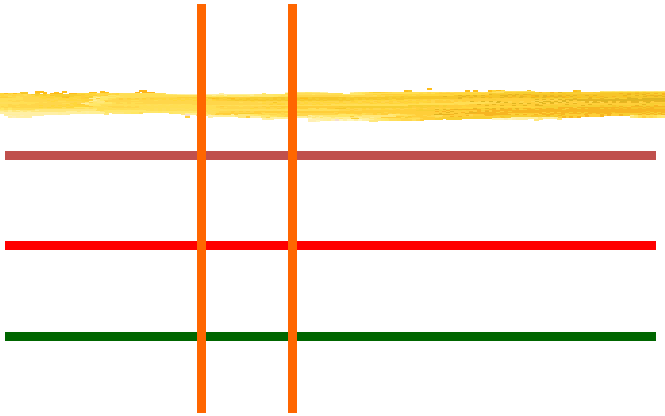


Asp. carbonarius

PCR-DGGE *(Polymerase Chain Reaction-Denaturing Gradient Gel Electrophoresis)*



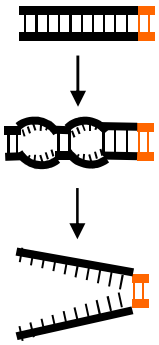
Same size amplicons



Fungi 1

Fungi 2

Fungi 3



ATGC

TACG

GCCGGC

CGGCCG

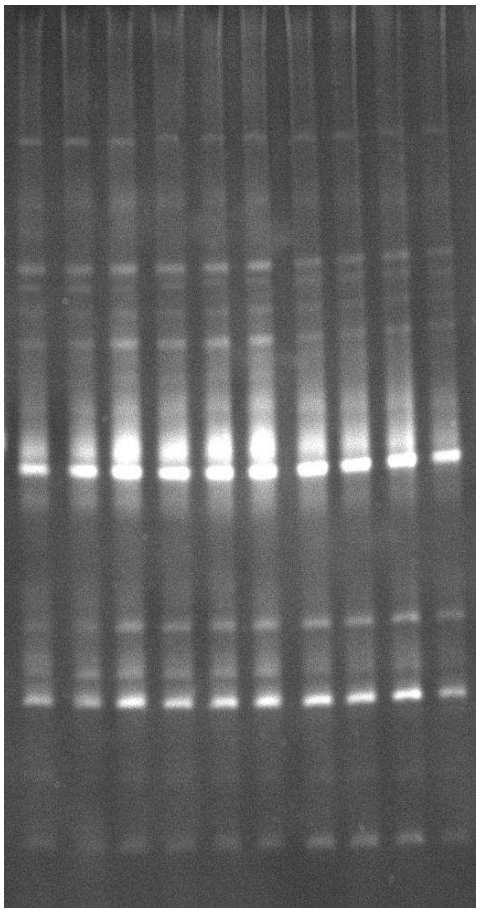
GC clamp

Repetability

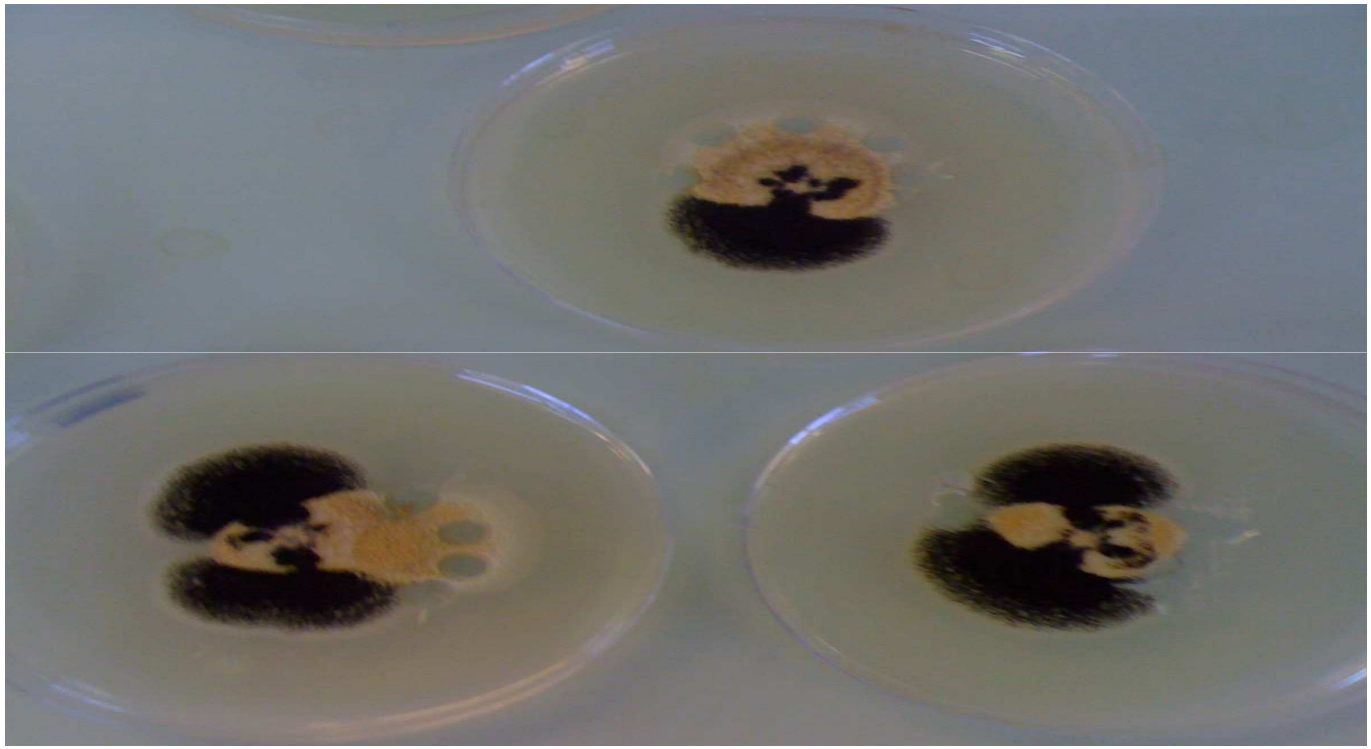
10 samples of the same lot

Coffee Ivory Coast

- Extraction
- Purification
- PCR
- DGGE



Competition between an inhibitor and *Asp. Westerdijikae*



Biological fighting

Preservation of fruits by the lactoperoxydase system linked to chitosan: case of mango

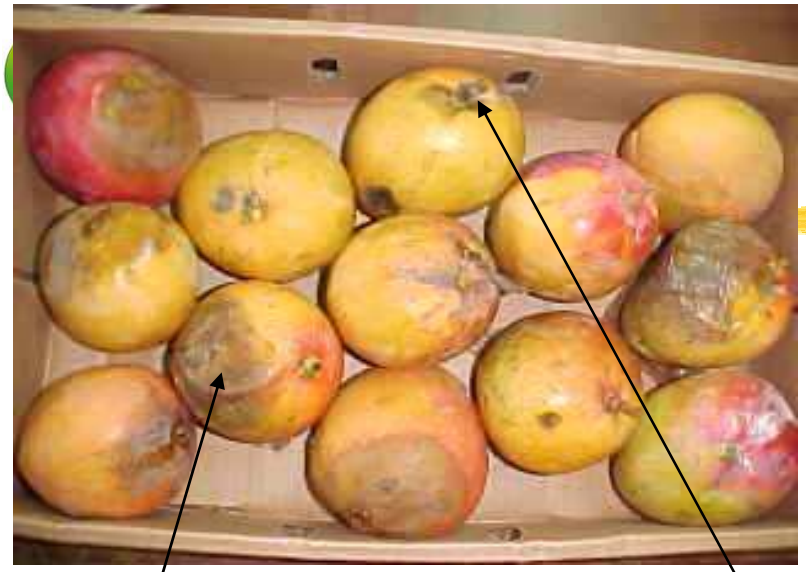
$$2\ SCN^- + H_2O_2 \xrightarrow{LPO} 2\ OSCN^- + 2\ H^+ + 2e^-$$

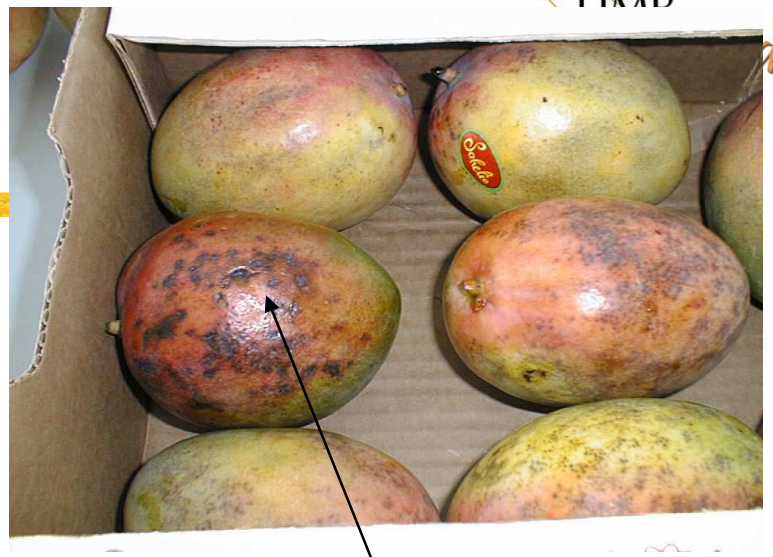
$$OSCN^- + \text{protein-SH} \longrightarrow \text{protein-S-SCN} + OH^-$$

Oxydation of sulphydryl proteins (enzymes) catalysed by LPO

Effect of LPS on microorganisms

- Structural damages or cytoplasmic membrane modifications
- Inhibition of the consumption of glucose, purines and amino acids and also of the protein synthesis





Xanthomonas spp.

Botryodiplodia.spp

Colletotrichum spp.
Anthracnose

CHEMICAL PROTECTION

- Fongicides
- Bactericides

Stem end rot

PROBLEMS

- Traces of residue on fruits after traitment

Results

Non coated

Ripening(7 days)

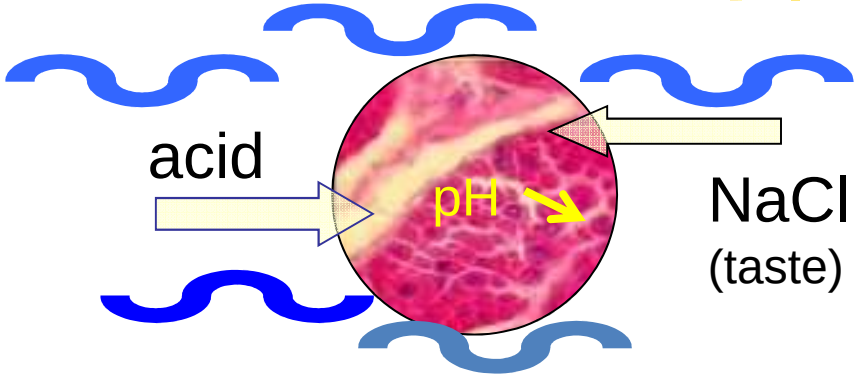
Microbiological quality(12 days)

Coated

1,5% Chitosan

1,5% Chit-LPS

Salt soaking process



pH 4 to 5

4 fonctions

Typical taste

Decontamination
Preservation

Tendering

Hight salt
transfers

Ex :tandoori; ceviche

Thanks!

Technology house, Cirad, Montpellier, France

Membrane technology for juice stabilization & concentration without temperature

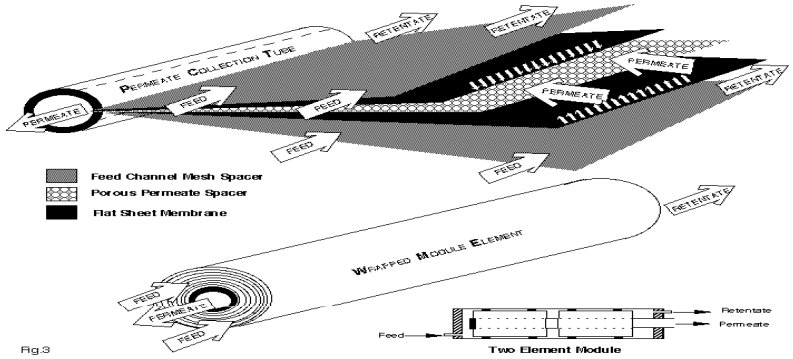
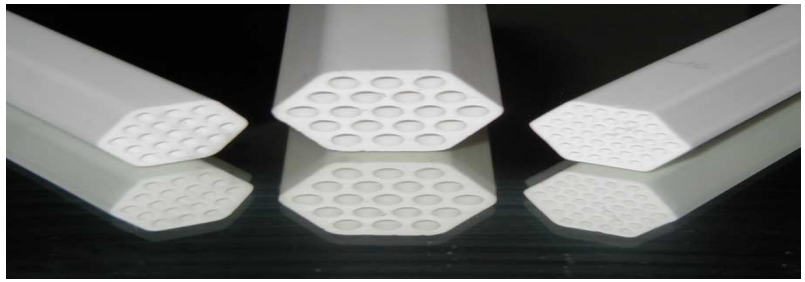


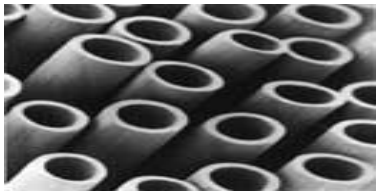
Fig.3

Tubular multichannel (ceramic)



1 cm

Hollow fibers (organic)



1 mm

Membrane technology for juice

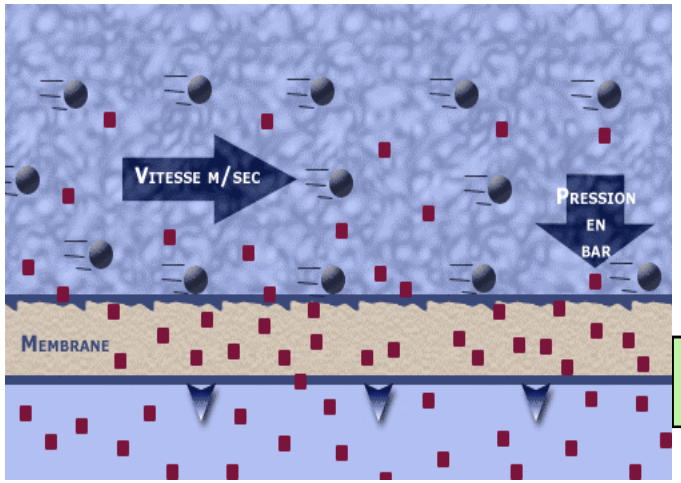
Pulpy juice

Membrane 0,2 mm

T < 35 °C

Enzymatic treatment

- free enzymes
- linked in bioreactor



sterile permeat

Clarified Juice

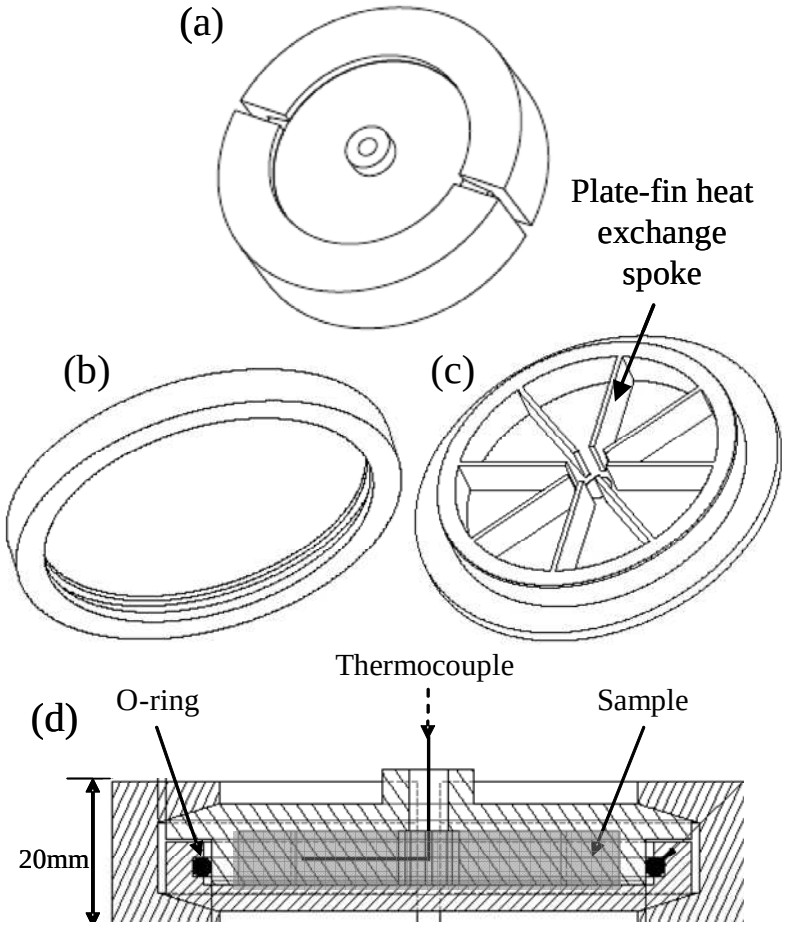
rétentat

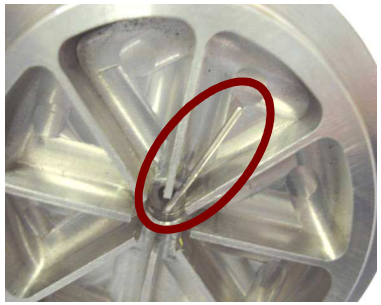
Pasteurization

Pulpy juice stabilised With hight quality

A reactor to study behavior of food product at high temperature to simulate frying conditions

Product was heated in a hermetically sealed test cell that was custom-designed in stainless steel.
The inner diameter was 50 mm and the inner height 7 mm.
Reactor capacity was 0.02 L of samples





Thermocouple located at the geometrical centre of one compartment

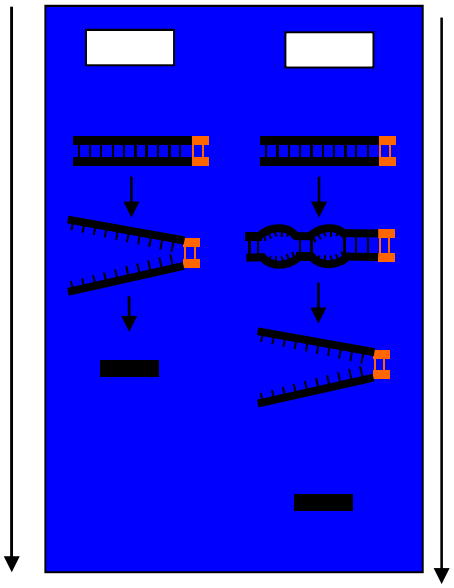
DGGE

Double strand DNA of the same size from PCR

DNA most rich in GC

One band = one strain or one clone

DNA less rich in GC



Least concentrated in denaturing agents

Linear gradient of denaturings Agents (urea/formamide)

Most concentrated in denaturing agents

Problématique scientifique

Réactivité

Matrice

Variables procédé :

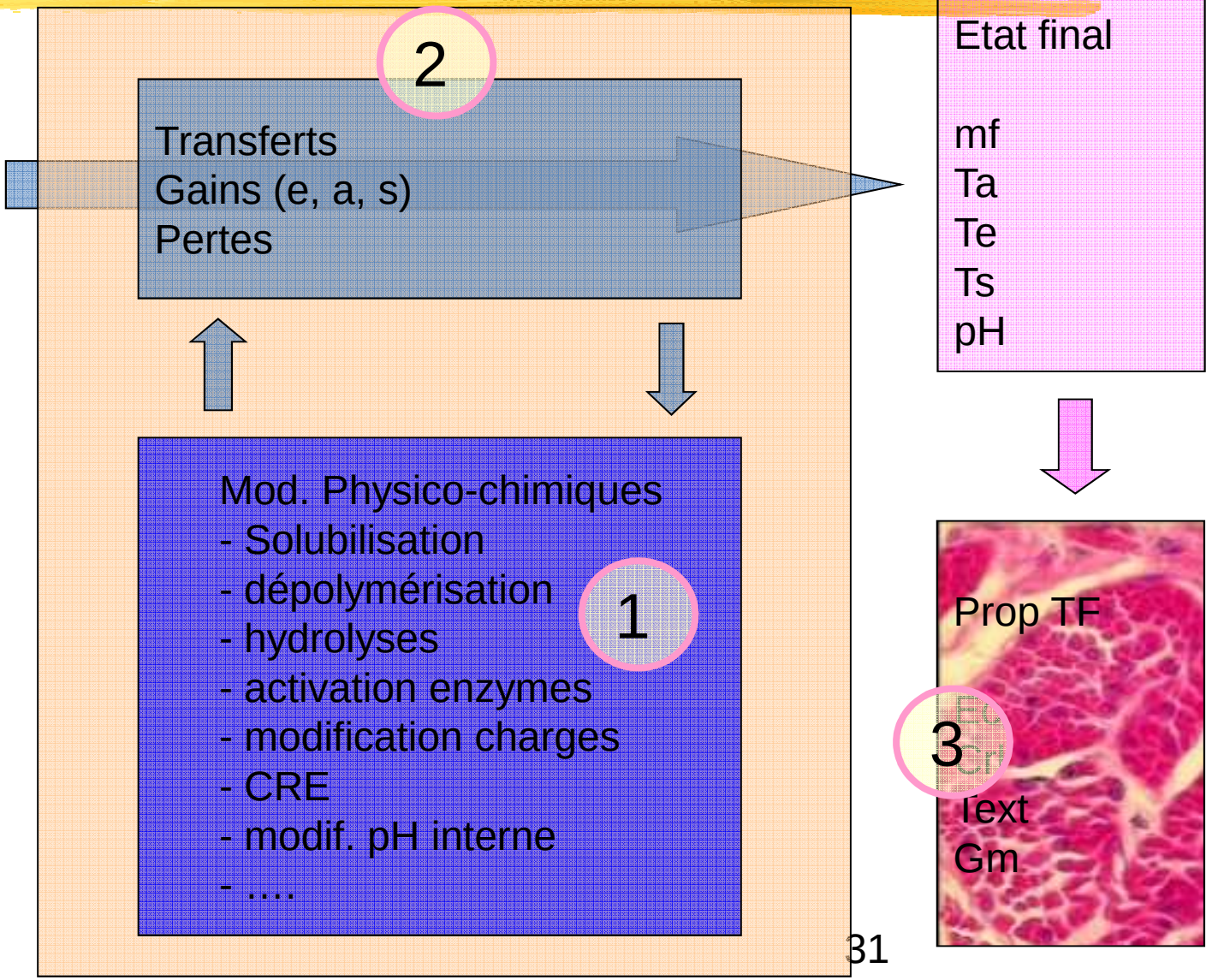
Nature acide

Ka

Tsel

Temps

~~[AH] [NaCl]~~



1. Appréhender les équilibres chimiques dans la viande durant l'acidification ; distribution des espèces chimiques

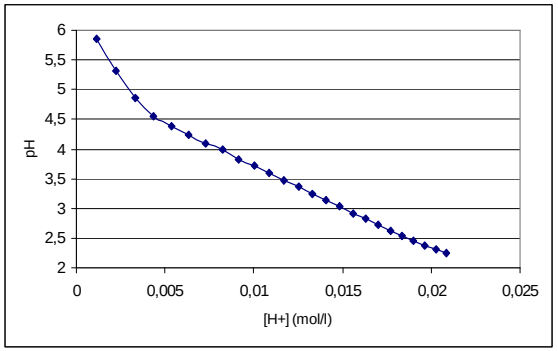
2. Etudier la dynamique et les mécanismes des transferts de matières

3. Relier équilibres et dynamique transferts aux modifications des propriétés techno fonctionnelles (CR/, texture…).

Equilibres chimiques

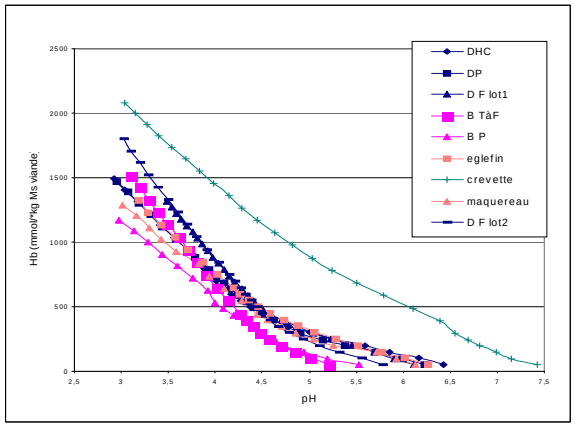
« Signature de la viande »

$$[H_b] = [HCl] - 10^{(-pH)}$$

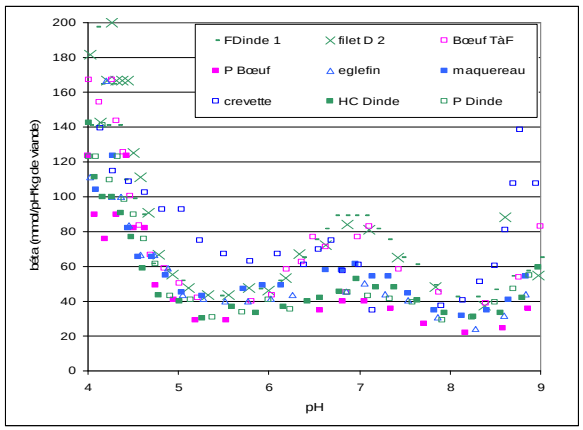


Courbe de titration

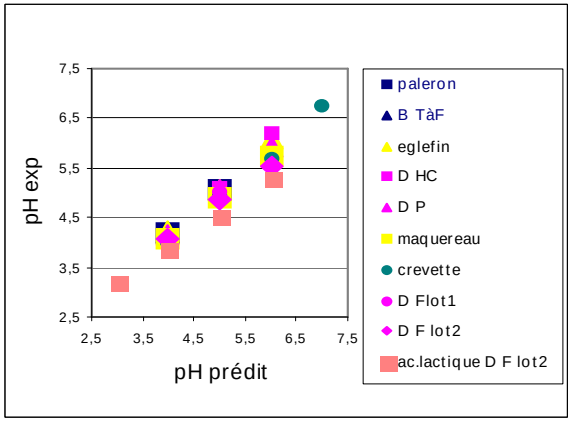
Relation pH/H_b



Pouvoir tampon



Prédiction de pH



mécanismes transferts/déformations

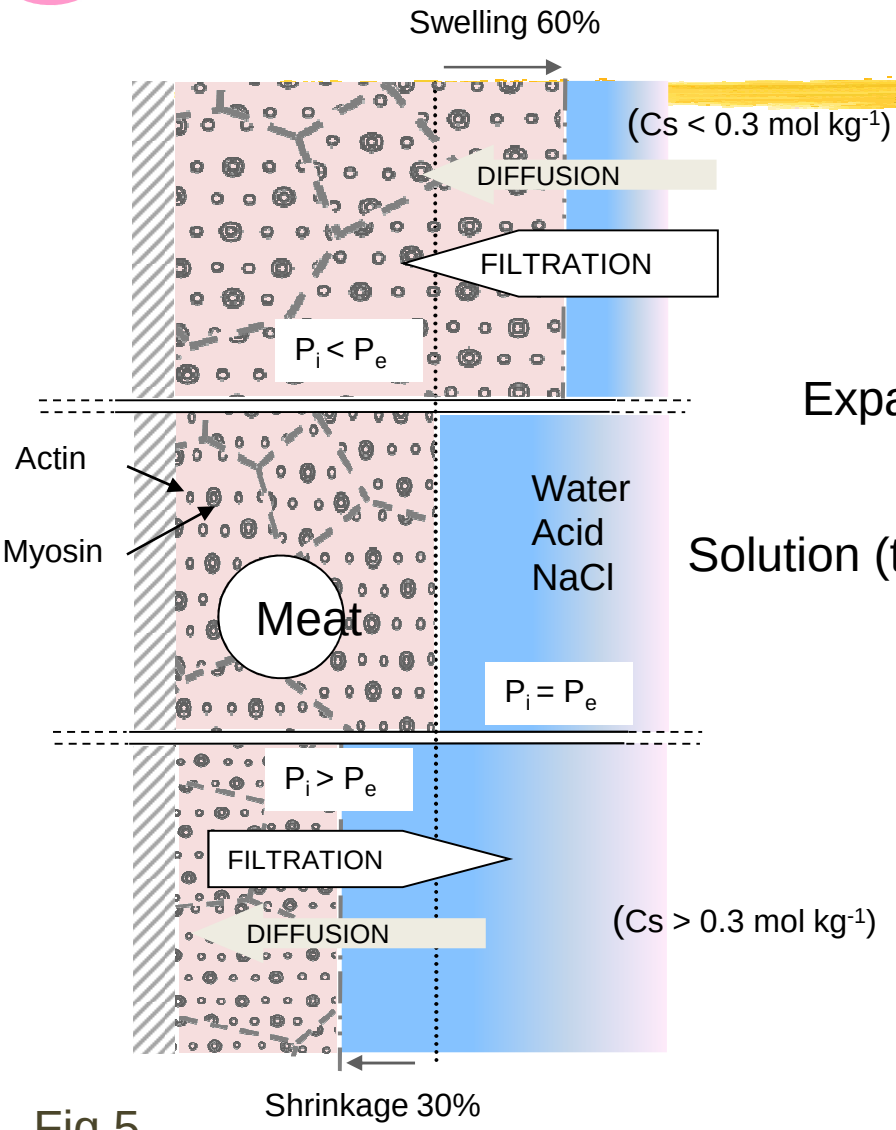
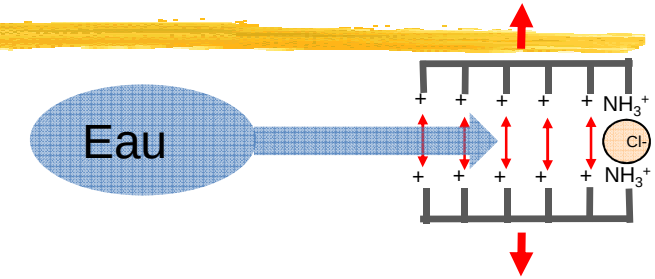
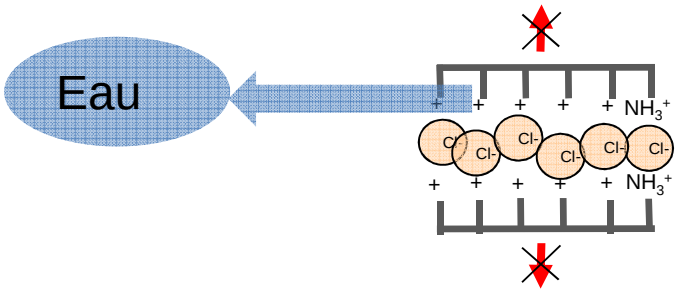


Fig.5



Expansion = osmose + répulsion ES

Force motrice filtration = ΔP

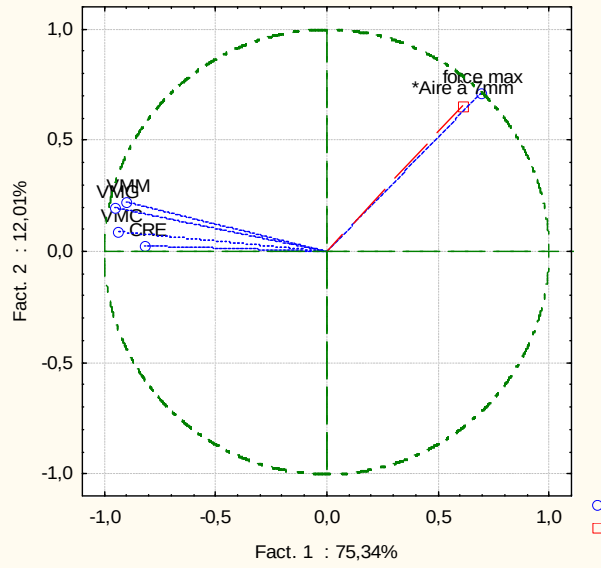


Contraction = osmose + baisse répulsion ES

3 Modifications des propriétés techno fonctionnelles

3 muscles de dinde, solutions binaires et ternaires (AA et NaCl 0,25M)

Effet	Résultats Univariés pour chaque VD (texture 13 02 09) Paramétrisation sigma-restreinte Décomposition efficace de l'hypothèse				
	Degr. de Liberté	force max SC	force max MC	force max F	force max p
ord. origine	1	57324727	57324727	1083,086	0,000000
Bain	3	4101461	1367154	25,831	0,000000
Muscle	2	2336308	1168154	22,071	0,000000
Bain*Muscle	6	3732935	622156	11,755	0,000000
Erreur	57	3016852	52927		
Total	68	13216178			



Dureté de la viande (cuite) corrélée négativement avec les variations de masse des viandes marinées crues ou cuites, CRE.

Ternaires : les + fermes, VM les + faibles
Acide seul : les + tendres, VM les + fortes
3 muscles confondus.